

Program for UV Intercomparison 2014 in Davos:

June 2014

Date: 7–16 July 2014
Location: PMOD/WRC Davos Switzerland.
Information Update: <http://projects.pmodwrc.ch/env03/index.php/8-emrp-uv/project/24-intercomparison-2014>
Registration: <http://projects.pmodwrc.ch/env03/index.php/9-emrp-uv/main/19-uvnet-workshop>

Schedule:

7 July from 9 am: Installation of all instruments on observation roof at PMOD/WRC
8–16 July: Continuous QASUME operation. Visiting end-user instruments will be compared to QASUME during this period when not being calibrated or characterized in the laboratory.
8–14 July: Characterization of end-user instruments with the new facilities developed within the ENV03 project (Services 1–3).
16 July from 1 pm: Removal and packing of all instruments.

Generally, the instruments will measure global spectra during the entire intercomparison period on the roof at PMOD/WRC, in particular during sunny clear sky days (at least 2 entire days). In the event of bad weather, the instruments will be brought to the specific locations (“market stands”) for calibration and characterization. The availability of the “market stands” will be arranged with the operator on-site. The consortium offers **3 services** available at different “market stands”, details below.

Service 1 – Quality Assurance of solar measurements:

QASUME portable reference – PMOD/WRC Roof / Computerroom – PMOD (what – where – who as operator)
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Note:

All instruments will be operated outdoor on the PMOD/WRC roof. If a fiber connection of >5 m is available, there is the option to operate certain instruments indoors. Please let the organizing committee know if your instrument has this requirement.

Measurement report:

- QASUME will measure global irradiance from 290 nm to 500 nm on a 30 min. schedule while one scan takes about 20 min. (QASUME standard).
- End-user instrument will measure global irradiance on its wavelength range.
- Scanning instruments should be time-synchronized with the QASUME measurements (end-user should take care of their own instruments' time schedule). Required data format for

matlab matshic input is ASCII with following columns: [wavelength; irradiance [W/m²/nm]; (and optional time vector)]. Timestamped filename should be as follows: 3 character day of year, hhmm.instrument-abbreviation: e.g. 0530800.jrc for JRC instrument scan measured on day 053 at 08:00).

Example file contents:

```
%100913 25313 08:00:00 08:00:00 60.7 25.2C 45.742 -7.357 INST=5503
UV uvr W/m^2/nm
290.00 0.000000e+000 8.000360
290.25 0.000000e+000 8.000760
290.50 0.000000e+000 8.001170
290.75 0.000000e+000 8.001590
291.00 0.000000e+000 8.001990
291.25 0.000000e+000 8.002400
291.50 0.000000e+000 8.002810
```

- **For array spectroradiometers:** It is anticipated that QASUME will scan a rate of 3s/nm and ideally array instruments will acquire data every few seconds to synchronize with this. In any event the specific time interval of data acquisition will be discussed with the end-user according to the specific instrument with PMOD, REG(IMU), REG(UoM) (see also 3A, 3B).
- Stray light correction is given by REG(IMU) in point 3A. Bandwidth/wavelength correction with matshic (Data format: matshic output), and time-synchronization on an appropriate time average is given by PMOD in point 3B.
- Data should be handed out to PMOD/REG(IMU) at latest by the evening of a measurement day (ideally transferred by ftp in real time).
- PMOD will analyze the data based on the standard QASUME procedures.
- Data and plots from PMOD analysis ("plot_qasume") for the Intercomparison Report.

Service 2 – Characterization of Instruments in the laboratory:

A) Irradiance scale

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| <ol style="list-style-type: none">1. LDLS – Optic Labor 1/Roof – VSL2. Portable lamp calibration for Schreder entrance optics – Field – PMOD3. Portable lamp calibration for Brewer – Field – PMOD4. 1000 Watt setup – Optic Labor 2 – PMOD |
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Measurement report:

- End-user receives spectral irradiance reference (file format: [wavelength, irradiance]) to determine the responsivity of the spectroradiometer (including stray light correction point 3A).
- End-user analyses his lamp calibration data and compares his scale with the scale of the WCC-UV reference (QASUME).
- Operator sends uncertainty estimation to LNE, point 3C.

- Result: ratio of end-user scale to WCC-UV.
- Data from end-user analysis for the Intercomparison Report to PMOD.

B) Non Linearity

Non linearity device – Optic Labor 1/Roof – **VSL**

Measurement report:

- End-user receives device-signal at specific time of measurement from VSL (data format: time [hour.decimal], device signal [counts]). End-user receives linearity deviation in terms of counts
- Operator sends uncertainty estimation to LNE, point 3C.
- Data from end-user analysis for the Intercomparison Report to PMOD.

C) Slit functions / Line spread functions

Spectral lamp / Laser – Optic Labor 2 – **PMOD**

Measurement report:

End-user creates slit and line spread functions and hand it out to PMOD (data format: a) wavelength, slit function, b) wavelength, irradiance [W/m^2]) to be applied in point 2D and 3B.

Note:

The proper measurement of the line spread function depends on the characteristics of the instrument (e.g. blooming effect when saturating array detectors.)

D) Wavelength Calibration

Wavelength Scale Device – Optic Labor 1/Roof – **VLS/Metas**

Measurement report:

- VSL/Metas receives calibrated spectrum from end-user (data format: [wavelength spectral irradiance] and slit function(s) from point 2C)
- End-user receives dispersion relation pixel to wavelength from VSL/Metas.
- End-user analyses his original dispersion relation to this one – output: Wavelength-shift – end-users-calibration -> operator's estimate (and wavelength-shift from point 3B)
- Operator sends uncertainty estimation to LNE, point 3C.
- Data from end-user analysis for the Intercomparison Report to PMOD.

E) Angular Response Function

Angular Response Function setup – Optic Labor 1&2/Field – **PMOD**/ Jose Manuel (**INTA**) for Brewer

Measurement report:

- Operator receives data from the end-user on a specific format according to the setup.
 - PMOD and INTA analyses the angular response for at least 2 planes. Data from operator's analysis for the Intercomparison Report.
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Service 3 – Data Post Processing:

A) Stray Light Correction

Straylight Correction Matrix – Computerroom – **REG(IMU)**

Measurement report:

- Operator receives line spread functions from end-user.
- Operator creates stray light correction matrix according to Zong et al. interpolated to all wavelength of the end-user instrument.
- End-user receives stray light correction matrix.
- Operator sends uncertainty estimation to LNE, based on information from the end-user, point 3C.
- Operator applies stray light correction matrix to lamp calibration measurements (point 2A) and solar measurements (point 1).
- Operator sends stray light corrected solar measurements to PMOD for matshic (point 3B).

Note:

The quality of the stray light correction is limited by the quality of the LSF (point 2C) and the knowledge about the out-of-range-straylight, therefore it may not be possible to make a sufficient stray light correction for an individual array spectroradiometer. The end-user and operator can discuss details further.

B) Bandwidth and wavelength correction algorithm (“matshic”) and time synchronization

matshic – Computerroom – **PMOD**

Measurement report:

- Operator receives responsivity (point 2A) and solar measurements (point 1) from end-user. For array spectroradiometer also including stray light correction (point 3A).
- Operator creates homogenized solar spectra and estimates wavelength-shift for comparison with point 2D.
- For the quality assurance (point 1), PMOD also creates time synchronized spectra to be compared with QASUME portable reference.

C) Uncertainty Estimation

“Uncertainty”-Software – Computerroom – **LNE**

Measurement report:

- LNE receives:
 - a) Measurement files for the spectroradiometer calibration and sun measurement, corrected for wavelength and linearity (from point 1 and 2A).
 - b) Dark files (from End-User)
 - c) Stray light correction matrix (from point 3A)
 - d) Spectroradiometer calibration file (from 2A)
 - e) Sun measurement corrected for stray light (from 3A)
 - f) Uncertainty of the stray light correction matrix (from 2D)
 - g) Uncertainty for the wavelength scale calibration (from 2D)
 - h) Standard lamp calibration (280 nm–400 nm), (from 2A)
 - i) Uncertainty on standard lamp calibration (280 nm–400 nm), (from 2A)
 - j) Uncertainty on standard lamp current setting (280 nm–400 nm) (from 2A)
 - k) Uncertainty on standard lamp distance (280 nm–400 nm), (from 2A)
 - l) Uncertainty on linearity calibration (from 2B)
 - m) Uncertainty on time integration calibration (from end-user)
- End-user receives uncertainty budget from LNE
- Operator sends uncertainty budget to PMOD for report.

Additional Services:

Hyper spectral Camera:

- **INRIM** will operate the hyperspectral camera
- **PMOD** will operate a visible sky camera extracting the region around 400.nm (blue channel)

Climate chamber:

- In case of specific open questions in regard to temperature dependence of some end-user instruments, the climate chamber at PMOD/WRC may be used for additional measurements.

The outcome should be preliminary for the improvement of the end-user's instrument and may not necessarily be reported.

Note:

All data for the report should be finished by end of the campaign and handed out to PMOD to assemble the final report.